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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for July, 1887, and is based upon reports of regular and voluntary observers of both countries. Descriptions of the storms which occurred over the north Atlantic Ocean during the month are also given, and their approximate paths shown on chart i, on which also appears the distribution of icebergs and field ice reported. In tracing the centres of the paths of these storms, data from the reports of two hundred and twenty-seven vessels have been used. The storms which occurred over the ocean were rather evenly distributed throughout the month, and developed greatest energy to the eastward of the fortieth meridian; barometric pressure below 29.00 inches (762.0 mm.) being reported on two dates. There was an unusual prevalence of fog in the vicinity of Newfoundland, and the dotted shading on chart i shows the limits of the fog-belts to the westward of the fortieth meridian.

The average number of areas of low pressure for July during the last fourteen years is *nine*; on chart i for the present month are traced the paths of seven such areas, or two less than the average for July.

Over the central and northern portions of the country to the east of the Rocky Mountains the most noteworthy meteorological feature of this month is the unusually high mean temperature, the region of greatest excess of heat being the lower lake region and portions of the Ohio Valley and middle Atlantic states, where the temperature averaged from 4° to 7° above the normal. Chart v exhibits, for selected stations in the heated area, curves illustrating the current and normal temperatures of July, and will be found of especial interest, as this month over a large part of the country has been the warmest that has occurred since the establishment of Signal Service stations.

The monthly precipitation for the Atlantic coast and east Gulf states, extreme northwest, and for portions of the middle and southern Rocky Mountain districts, is generally in excess of the average; in the Lake region, central valleys, and west Gulf states it is below the average.

The very heavy rains near the close of the month in Georgia and South Carolina, caused a destructive freshet in the Savannah River, which at Augusta, Ga., was higher than has been known for more than twenty years. Local freshets in the smaller streams were numerous during the month in the states bordering on the Atlantic.

In the preparation of this REVIEW the following data, received up to August 20, 1887, have been used, viz., the regular tri-daily weather-charts, containing data of simultaneous observations taken at one hundred and thirty-three Signal Service stations and twenty-four Canadian stations, as telegraphed to this office; one hundred and sixty-seven monthly journals and one hundred and sixty-nine monthly means from the former and twenty-four monthly means from the latter; two hundred and sixty-nine monthly registers from voluntary observers; sixty monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the "New York Herald Weather Service;" abstracts of ships' logs furnished by the publishers of "The New York Maritime Register;" monthly weather reports from the local weather services of Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New England, New Jersey, North Carolina, Ohio, Oregon, South Carolina, and Tennessee; and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean pressure for July, 1887, determined from the tri-daily telegraphic observations of the Signal Service, is shown by isobarometric lines on chart ii. The area of maximum pressure for July is shown by the isobar of 30.1, and occupies the north Pacific coast; the area of minimum pressure covers portions of the southern and middle plateau districts, and is indicated by the isobar of 29.85. The mean pressure over all the districts to the east of the Rocky Mountains generally ranges between 29.9 and 30.0, being greater over the southern portions of the country than in the northern districts.

Compared with the mean pressure for the preceding month, an increase is shown along the south Atlantic and Gulf coasts, and over the entire country from the Mississippi River to the Pacific coast; the excess is more than .10 over nearly all of the Rocky Mountain region, and over portions of the middle and southern plateau districts it amounts to .15 or more. To the eastward of the Mississippi, north of the thirty-fifth parallel, the mean pressure for July is slightly below that for June, the deficiency being less than .05, except in the Saint Lawrence Valley, New England, and the Maritime Provinces of Canada, where it is .05, or slightly more.

The departures from the normal pressure for the various stations are given in the tables of miscellaneous meteorological data; they are also graphically exhibited on chart iv by lines connecting stations of normal or equal abnormal values. As will be seen from this chart the mean pressure for July is about normal over nearly the whole country; the maximum deficiency being .03, and the maximum excess, .06. The region over which a deficiency occurs extends from the Gulf of Mexico northward to the Lake region, Minnesota, and Dakota, while in all other districts the mean pressure is normal or slightly above.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are also given in the table of miscellaneous data. The following are some of the extremes:

Greatest.		Least.	
	Inch.		*Inch.*
Duluth, Minn	0.69	San Diego, Cal	0.22
Alpena, Mich	0.67	Key West, Fla	0.23
Boston, Mass	0.66	Cedar Keys, Fla	0.23
Mount Washington, N. H	0.65	Brownsville, Tex	0.25
New Haven, Conn	0.64	Rio Grande City, Tex	0.27
Marquette, Mich	0.63	Corpus Christi, Tex	0.27
Mackinaw City, Mich	0.62	Los Angeles, Cal	0.27

AREAS OF HIGH PRESSURE.

In the examination of the tri-daily weather charts, constructed with reports received from the Dominion of Canada and all parts of the United States, eight well-defined areas of high pressure have been traced with sufficient accuracy to warrant a brief description of them. The general direction of movement of these high areas has been easterly, with the exception of numbers iii and v, which was southerly. Six of these areas first appeared off the coast of Oregon and Washington Territory; one moved southwestward from the vicinity of Newfoundland, and the remaining one passed northeastward along the Atlantic coast. In tracing their tracks it was noticed that a high area prevailed during nearly the whole month off the coast of Oregon and Washington Territory, and, at intervals, it would apparently start eastward, divide into two areas, one returning to the coast and the other taking an easterly course.

The attendant phenomena upon the areas traced for July have not been of such a positive character as to warrant a description of each. Light gradients, both in pressure and temperature, generally fair weather, and moderate wind velocities have been the general accompanying conditions.

The following are general descriptions of the tracks pursued by the several areas of high pressure:

I.—This area is a continuation of number iv for the month of June. On the 1st of July it was off the North Carolina coast, with a pressure of 30.24. It moved slowly northeastward and disappeared on the 6th off the coast of Nova Scotia.

II.—This area was central off the coast of Oregon on the 1st. After remaining in that vicinity for seven days it started rapidly eastward, arriving in West Virginia on the 12th. It then moved southward and left the east Florida coast on the 14th.

III.—The morning reports of the 7th located this area on the coast of Washington Territory. It remained in that vicinity until the 11th, when it started eastward over British Columbia and Manitoba, arriving over the Province of Ontario on the 15th. It then took a southwesterly course towards Texas, and disappeared off the Texas coast on the 18th.

IV.—This area was first located off the coast of Washington Territory on the 13th. It started eastward on the 16th and moved directly to Nebraska. It then changed its course to northeast and passed beyond Lake Superior on the 20th.

V.—The morning reports of the 19th indicated that a high area was approaching Nova Scotia from the north. It moved slowly southward, and after remaining off the coast of Nova Scotia until the 25th it disappeared.

VI.—This area was first located off the Oregon coast on the 21st. It moved rapidly eastward to Lake Huron; it then changed its course to the northeast and passed beyond the stations of observation on the 24th.

VII.—The morning reports of the 23d indicated the approach of a high area from the Pacific Ocean to the Oregon coast. It soon after appeared and moved over Washington Territory. It then changed its course and moved southeasterly into southern Dakota; it then passed directly eastward over the Lake region to the coast of Nova Scotia, where it disappeared on the 31st.

VIII.—On the morning of the 25th a pressure of 30.24 was reported from Washington Territory. The centre of the high area seemed to be to the northward. It moved into British Columbia and then started southeastward to Iowa. It then pursued a northeast course and was central north of Lake Huron on the 31st.

AREAS OF LOW PRESSURE.

Seven areas of low pressure have been defined and their paths traced from the tri-daily observations for the month of July. Chart i exhibits these paths. Three of the low areas were first noticed in the region north of Montana, the fourth in Colorado, the fifth in Iowa, the sixth north of the Province of Quebec, and the seventh in the vicinity of the Windward Islands, West Indies. The course of six of them was generally eastward, with several peculiar temporary deviations. The seventh followed the course usual for West Indies' cyclones, and will be more fully described hereinafter.

The following table shows the time first and last observed, latitude and longitude, and the average hourly velocity of each area of low pressure traced for July:

Areas of low pressure.	First observed.			Last observed.			Average progress in miles per hour.
	Date and time.	Lat. N.	Long. W.	Date and time.	Lat. N.	Long. W.	
		° ′	° ′		° ′	° ′	
No. I	2, 3 p. m.	36 00	102 00	8, 3 p. m.	49 00	57 00	20.0
II	7, 3 p. m.	53 00	111 00	11, 10 p. m.	43 00	00 00	23.0
III	8, 11 p. m.	54 00	116 00	11, 7 a. m.	97 00	43 00	23.0
IV	13, 7 a. m.	52 00	70 00	14, 3 p. m.	47 00	59 00	20.0
V	13, 2 p. m.	52 00	115 00	19, 7 a. m.	36 00	75 00	32.0
VI	20, 10 p. m.	41 30	92 00	23, 3 p. m.	51 00	67 00	38.0
VII	22, 7 a. m.	15 00	70 00	31, 10 p. m.	34 00	89 00	10.0

Average rate of progress, 22.6 miles per hour.

The following are brief descriptions of the areas of low pressure traced, with mention of some of the more important meteorological conditions attending them:

I.—The afternoon reports of the 22d indicated the presence of a light barometric depression in southern Colorado, with a minimum pressure of 29.74. It at once moved to Lake Superior, with a decrease in pressure to 29.68. Its subsequent course was eastward, passing over the lower Saint Lawrence valley and Newfoundland, leaving the coast on the 8th, with a central pressure of 29.42. It was attended in its whole course by light rain and occasional brisk winds.

II.—On the afternoon of the 7th a pressure of 29.68 was reported from the region just north of Montana. Subsequent reports disclosed a well developed area of low pressure. It moved over a path slightly south of east and passed off the New England coast on the 11th, with a minimum pressure of 29.56. Light rains and fresh to brisk winds prevailed in its vicinity during its eastward progress.

III.—This area of low pressure was first noticed in the Saskatchewan Valley on the evening of the 8th, with a minimum pressure of 29.68. It moved slowly southeastward into southern Dakota where it disappeared on the 11th. Light rains fell in Nebraska and Dakota along its path.

IV.—A low area appeared in the lower Saint Lawrence valley on the morning of the 13th, accompanied by light rains and fresh winds. It at once moved eastward and passed beyond the field of observation on the afternoon of the 14th.

V.—The pressure on the afternoon of the 13th was reported as 29.50 in the region just north of Montana. Subsequent reports indicated that a well defined low area was moving southeastward. On the 14th it was central in eastern Dakota. On the 15th it had moved southwestward into Colorado. It at once began moving northeast and was over Lake Superior on the 16th. Its course was then changed to southeast and it passed over lower New England on the 18th. It afterwards moved southward along the coast to Virginia and disappeared on the 19th. During its whole progress its gradient was very light, often not averaging one-tenth of an inch for two hundred miles. Occasionally light rains and light winds prevailed along its path.

VI.—The evening reports of the 20th from the central Mississippi valley defined a slight barometric depression accompanied by an area of cloud and rain. The rain-area rapidly spread over the country eastward to the Atlantic coast, and the low pressure area slowly moved eastward to Indiana and then northeastward to the lower Saint Lawrence valley, disappearing on the 23d. The extended area of rain which prevailed during the progress of this low area was remarkable, covering the entire country east of the Mississippi River.

VII.—This low area was the only depression which passed within the limits of observation during the month that proved to be dangerous to all classes of vessels. Its first appearance

and subsequent course entitle it to be placed among that class of storms known as West Indies' cyclones.

The following report of Mr. A. P. Goodman, mate of bark "Florence," of Boston, located at Barbadoes during the time it prevailed in that vicinity, will illustrate its severity:

July 20th.—During the last two days we have had light squally weather, with rain showers and very close, sultry weather and a falling glass. At 4 a. m., Greenwich time, 20th of July, the weather commenced to threaten, the glass having fallen to 29.64. We put out extra ropes and lines and made all secure for a blow; at 6 a. m. blowing heavy, with squalls of rain and a sea rolling in from the sse.; 7.30, wind increasing in the squalls; 8.30, in a terrific squall we parted all our lines and drove over to the other side of the Creek, doing considerable damage; about the same time we saw distress signals out to the Roads, and when daylight broke it was something terrific to look at, there being no less two barks, one barkentine, one brigantine, one two-masted schooner, one small steamer, and two condemned vessels on the shore; one bark and barkentine completely broken up; the sea was like a mountain on the shore.

The path pursued by this cyclone, as determined by a number of vessels' logs, reports, and observations received from vessels sailing on the Gulf of Mexico, the Caribbean Sea, and vicinity, appears to have been a little south of Barbadoes on the 20th, moving east. It then moved eastward over the central portion of the Caribbean Sea just north of N. 15° to W. 85°, then northwest over the extreme eastern portion of Yucatan to about N. 25°. At about the latter point its path seems to have been northerly for a few degrees and then changed to northeast. It arrived on the coast of western Florida on the morning of the 27th, with a minimum pressure of 29.60 and a wind-velocity of fifty-four miles per hour or more. After reaching the coast of Florida its course continued northeast to the vicinity of Augusta, Ga., then westward, arriving in northern Mississippi on the evening of the 31st, where it finally disapeared early in August. Its progress through the Caribbean Sea and the Gulf of Mexico appears to have been between fifteen and twenty miles per hour, and was accompanied by destructive winds and heavy rainfall. Reports of a number of vessels wrecked have been received from the western Florida and northern Cuban coasts.

The progress of the cyclone after leaving the Gulf of Mexico was reduced to about ten miles per hour. Its violence also appears to have been slightly reduced, judging from the following maximum wind-velocities, in miles per hour: Cedar Keys, Fla., 54; Pensacola, Fla., 36; Jacksonville, Fla., 36; Savannah, Ga., 36; Augusta, Ga., 20; Atlanta, Ga., 30; Mobile, Ala., 26. The rainfall was very heavy in Florida, Georgia, and eastern Alabama. The following are the total amounts, in inches, reported during the time the influence of the cyclone prevailed: Jacksonville, Fla., 3.50; Titusville, Fla., 4.54; Cedar Keys, Fla., 8.00; Pensacola, Fla., 1.34; Montgomery, Ala., 3.57; Atlanta, Ga., 8.93, and Augusta, Ga., 6.02. This heavy rainfall, in connection with the high winds and swollen rivers, was very destructive to the growing crops and public highways.

Through the kindness of Padre B. Viñes, S. J., Director of the Magnetic and Meteorological Observatory, Belen College, Havana, Cuba, the Chief Signal Officer was kept informed by telegraph of the progress of the cyclone before it reached the coast of the United States, and timely warning was given to the shipping on the Gulf and south Atlantic coasts, both by cautionary wind signals and special storm messages.

NORTH ATLANTIC STORMS DURING JULY, 1887.

[*Pressure in inches and millimetres; wind-force by Beaufort scale.*]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined, approximately, from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; abstracts of ships' logs and other data collected by the Signal Service agencies at the ports of New York, Boston, and Philadelphia; reports received through the co-operation of the "New York Herald Weather Service;" and from other miscellaneous data received at this office up to August 21, 1887.

Seven depressions are traced, of which two passed eastward over the northern extremity of Newfoundland and advanced to the northward of the British Isles; two moved eastward from the coast of the United States south of the forty-fifth parallel, and three first appeared over mid-ocean. The general course of direction of the depressions was east-northeast, and their rate of progression was, as a rule, slow. Barometric pressure ranging below 29.00 (736.6) was reported on the 8th over mid-ocean, and on the 26th to the southward of Iceland.

The more severe storms of the month were included within three periods, viz., from the 7th to the 12th hard gales prevailed over mid-ocean, attending the passage of depressions numbers 2 and 3; during the 13th, 14th, and 15th fresh gales were occasioned to the southward and eastward of Newfoundland by depression number 4, and from the 25th to the 28th, inclusive, fresh to whole gales occurred from the thirtieth meridian to the British Isles, accompanying depressions numbers 6 and 7. No storm of marked violence occurred off the Atlantic coast of the United States, although moderate gales and unsettled weather were reported west of the fifty-fifth meridian and north of the thirty-fifth parallel during the greater portion of the second and the latter part of the third decades of the month.

From the 11th to the 14th, inclusive, and during the 27th and 28th, the barometric pressure in the vicinity of the Azores was relatively low; during the balance of the month the barometer continued high in that locality. Over mid-ocean the pressure was high in the trans-Atlantic routes until the 5th, from which date until the 12th the barometer was generally low and fluctuating. During the second decade generally high pressure prevailed, except to the northward of the British Isles and west of the forty-fifth meridian. During the third decade the barometer continued low in, and to the northward of, the trans-Atlantic routes east of the thirty-fifth meridian. The cyclone which passed eastward over the Caribbean Sea and over the Gulf of Mexico during the third decade of the month is described under the heading of "Areas of low pressure."

In July, 1886, twelve depressions appeared over the ocean, of which seven were continuations of areas of low pressure traced on the North American continent; three storms traversed the ocean from coast to coast, one of which first appeared in the Caribbean Sea and passed into the Gulf of Mexico, whence it advanced northeast to the northward of the British Isles, closely following the course of the Gulf Stream.

In July, 1887, the storms, while being somewhat less frequent than in corresponding months of previous years, were of unusual summer strength to the eastward of the fortieth meridian during the three storm periods herein referred to.

The following are brief descriptions of the depressions traced:

1.—This depression was central on the 2d over the northern portion of the Gulf of Saint Lawrence, with barometric pressure ranging to about 29.70 (754.4), whence it moved northeast to about N. 54°, W. 51° by the 3d, with an apparent decrease in central pressure. During the next three days the storm-centre is given a probable track along the fifty-fifth parallel, after which it moved southeast and united with depression number 2 in N. 50°, W. 24° on the 7th.

2.—This depression originated southeast of the Banks of Newfoundland on the 6th, and, moving northeast, united with depression number 1 on the 7th, on which date barometric pressure about 29.30 (744.2) was shown. By the 8th the centre of depression had moved north-northeast to N. 55°, W. 21°,